

REMARKS

On pages 2 and 3 of the Office Action, the Examiner rejected claims 50-53, 58, and 59 under 35 U.S.C. §103(a) as being unpatentable over Andreiko in view of Chishti '511.

According to independent claim 50, a finite element analysis is performed based on an orthodontic treatment and a movement of the patient's teeth between only original positions of the patient's teeth and final positions of the patient's teeth.

Andreiko shows, in connection with Figures 2, an orthodontic method that includes a patient diagnosis and prescription evaluation 85 performed by an orthodontist in the orthodontist's office, a computer aided analysis and appliance design and manufacturing operation 87 performed at an appliance facility so as to produce a custom appliance, and a patient treatment operation (89) that includes the installation of the appliance.

During the patient diagnosis and prescription evaluation 85, the orthodontist examines the patient at 90, prepares a model of the patient's mouth and teeth in their initial conditions at 91, prescribes a treatment

and generates a prescription at 92, and communicates the model, the prescription, the identities of the orthodontist and the patient, and statistical and historic data of the patient to the appliance design and manufacturing facility at 93.

During the computer aided analysis and appliance design and manufacturing operation 87, the appliance design and manufacturing facility performs steps 94-98. At 94, the information supplied by the orthodontist at 93 is input into a computer and certain calculations regarding the geometry of the patient's mouth and teeth are made (see Figures 2E-2I). At 95, the inputted information is computer analyzed, mandibular and maxillary equations are derived from the data that described the finish positions of the teeth (Figures 2J-2O). At 96 these equations are used to determine equations defining the mandibular and maxillary archwires and brackets that are used to design the jig that will be used to mount the brackets (Figures 2P-2V). At 98, the archwires and brackets are manufactured (Figures 2X-2Z). At 98, the archwires and brackets and accompanying instructions are communicated to the orthodontist.

The Examiner states that, according to Andreiko, the step of designing appliances uses many different calculating methods to apply the desired forces to move the teeth between only original and final positions.

Taken literally, this statement of the Examiner means that the calculation methods apply the desired force to the patient's teeth. However, calculations cannot apply forces to teeth.

Taken non-literally, the Examiner may mean that forces on the patient's teeth are used in the calculations. However, there is no disclosure in Andreiko that forces are used in making any of the calculations, as can be seen by the flow charts and the equations of Andreiko.

Furthermore, force is mentioned in Andreiko only in connection with the appliances applying force to move the patient's teeth and in connection with "forcing symmetry" of the archwires. There is no disclosure of using force in making calculations. Certainly, Andreiko mentions nothing about analyzing the forces applied by the appliance 25 to the patient's teeth in order to determine how the appliance 25 will deform as the teeth

are moved, or to determine the stresses, strains, forces, friction, and moments that will be exerted on the appliance 25, teeth, PDL, and bone, or for any other reason.

Therefore, Andreiko suggests neither testing the treatment not testing the treatment using a finite element analysis.

Alternatively, the Examiner's statement might mean that Andreiko discloses the design and manufacture of a single appliance that moves the patient's teeth between only original and final positions. However, while Andreiko does state that "[t]he appliance so formed, when connected to the teeth of the patient, moves the teeth of the patient to precise calculated finish positions without the need for the orthodontist to bend archwires over the course of the treatment," Andreiko also states that "[o]ften, the first archwire installed will be one of lower stiffness than the final archwire." Thus, Andreiko suggests that the appliance 25 may comprise sets of archwires and brackets with each set moving the patient's during a corresponding stage of the treatment.

Consequently, Andreiko does not even suggest moving teeth using just two archwires (one lower and one upper) and a corresponding set of brackets. Therefore, Andreiko cannot suggest performing any analysis based on a movement of the patient's teeth between only original and final positions.

Moreover, even if Andreiko were to suggest moving teeth using just two archwires and a corresponding set of brackets, it still does not follow that Andreiko thereby suggests performing any analysis, much less a finite element analysis, on the appliance 25 based on a movement of the patient's teeth between only original and final positions.

Accordingly, for all of the reasons given above, Andreiko suggests neither testing the appliance based on a movement of the patient's teeth nor testing the appliance based on a movement of the patient's teeth between only original and final positions.

The Examiner also relies on Chishti '511 in the rejection of independent claim 50.

However, as is the case with Andreiko, Chishti '511 also does not disclose performing a finite element

analysis based on a movement of the patient's teeth between only original and final positions.

Therefore, because Andreiko does not suggest performing any analysis on a proposed treatment, and because neither Andreiko nor Chishti '511 discloses performing a finite element analysis based on a movement of the patient's teeth between only original and final positions, one skilled in the art would not have been led by Andreiko and Chishti '511 to the invention of independent claim 50.

Consequently, independent claim 50 is patentable over Andreiko in view of Chishti '511.

Moreover, Chishti '511 specifically discloses performing a finite element analysis based on the shape and material of each of a sequence of appliances to be applied to a patient. Therefore, Chishti '511 would have led the person of ordinary skill in the art away from the invention of independent claim 50.

Consequently, for this reason also, independent claim 50 is patentable over Andreiko in view of Chishti '511.

Furthermore, neither Andreiko nor Chishti '511 discloses or suggests the elimination of all intermediate

appliances. Indeed, as discussed above, Andreiko suggests the use of intermediate archwires. As also discussed above, Chishti '511 specifically teaches the use of a sequence of appliances.

Accordingly, because neither Andreiko nor Chishti '511 discloses or suggests eliminating all intermediate appliances, neither Andreiko nor Chishti '511 discloses or suggests the invention of independent claim 50.

Consequently, for this further reason, independent claim 50 is patentable over Andreiko in view of Chishti '511.

At the bottom of page 2 and carrying over to the top of page 3 of the Office Action, the Examiner argues that one of ordinary skill in the art would have combined Andreiko and Chishti '511 so as make use of a known way to improve the analysis of teeth movement. However, even if it would have been obvious to use the finite element analysis of Chishti '511 in the appliance manufacturing process of Andreiko, it would not have been obvious to perform the finite element analysis between only original and final positions for the three reasons give above.

Because independent claim 50 is patentable over Andreiko in view of Chishti '511, dependent claims 51-53, 58, and 59 are likewise patentable over Andreiko in view of Chishti '511.

On pages 3 and 4 of the Office Action, the Examiner rejected claims 54-57 under 35 U.S.C. §103(a) as being unpatentable over Andreiko in view of Chishti '511 and further in view of Chishti '310 and still further in view of Tang.

As pointed above, the combination of Andreiko and Chishti '511 would not have suggested the invention of independent claim 50 to one of ordinary skill in the art.

Chishti '310 discloses the use of intermediate positions and does not suggest performing a finite element analysis based on a movement of the patient's teeth between only original and final positions. Therefore, adding Chishti '310 to the combination of Andreiko and Chishti '511 does not disclose or suggest the invention of independent claim 50.

Tang discusses using a finite element surface model in predicting deformation of a sheet of metal during a draw forming process designed to form the sheet



metal into a part. However, Tang does not actually disclose or suggest performing a finite element analysis nor does Tang disclose or suggest performing a finite element analysis between only original and final positions.

Accordingly, because the combination of Andreiko, Chishti '511, Chishti '310, and Tang would not have suggested performing a finite element analysis between only initial and final positions, one of ordinary skill in the art would not have been led by Andreiko, Chishti '511, Chishti '310, and Tang to the invention of independent claim 50.

Consequently, independent claim 50 is patentable over Andreiko in view of Chishti '511 and further in view of Chishti '310 and still further in view of Tang.

Because independent claim 50 is patentable over Andreiko in view of Chishti '511 and further in view of Chishti '310 and still further in view of Tang, dependent claims 54-57 likewise are patentable over Andreiko in view of Chishti '511 and further in view of Chishti '310 and still further in view of Tang.

On pages 4 and 5 of the Office Action, the Examiner rejected claims 60, 61, 66-69, 103, 104, and 106 under 35 U.S.C. §103(a) as being unpatentable over Chishti '511 in view of Umeyama.

Independent claims 60 and 103 recite that a finite element analysis is performed based on contact pairs between orthodontic appliances.

Chishti '511 describes a method of providing a digital finite element model of a sequence of appliances to be applied to a patient, of providing a digital finite element model of the teeth and related mouth tissue of the patient, and of computing the effect of the appliances on the teeth by computationally analyzing the two models.

The Examiner recognizes that there is no disclosure in Chishti '511 of performing a finite element analysis based on contact pairs between orthodontic appliances. Indeed, Chishti '511 does not disclose such contact pairs at all.

Therefore, the Examiner relies on Umeyama.

Umeyama describes a method of designing and manufacturing gears so as to reduce the tear transmission

error. Umeyama describes this transmission error as gear noise.

According to Umeyama, transmission error is dependent in part on the bending deflection of the gear, and this bending deflection is calculated using an approximating formula which is obtained based on the finite-element method.

The Examiner then argues that it would have been obvious, in view of Umeyama, to have used a finite element analysis in Chishti '511 in order to analyze contact points so as to better model the loads in the system.

Assuming that this bending deflection results from contact between two gear teeth under load, then Umeyama is at most cumulative with Chishti '511. Neither reference discloses performing a finite element analysis based on contact between orthodontic appliances.

Chishti '511 states that the effect of the appliances on the teeth can be computed by computationally analyzing the two finite element models, i.e., the model of the appliance and the model of the teeth. Umeyama, given the assumption above, indicates

that a model for the bending deflection of teeth can be determined using the finite element method.

Therefore, Umeyama at the most suggests using the finite element method to analyzing forces between two gear teeth, with one tooth acting as the force applying appliance, and the other acting as the force receiving tooth. (Applicants do not admit that Umeyama actually makes this suggestion but are assuming the suggestion for the sake of argument.) Umeyama does not suggest using the finite element method to analyzing forces between appliances.

Consequently, one of ordinary skill in the art, upon reading Chishti '511 with Umeyama, would merely be led back to Chishti '511. Since the Examiner has admitted that Chishti '511 does not meet the limitations of independent claims 60 and 103, being led back to Chishti '511 by Umeyama would also fail to meet the limitations of independent claims 60 and 103.

Accordingly, independent claims 60 and 103 are patentable over Chishti '511 in view of Umeyama.

Because independent claims 60 and 103 of the present application are patentable over Chishti '511 in view of Umeyama, dependent claims 61, 66-69, 104, and 106

are likewise patentable over Chishti '511 in view of Umeyama.

On page 5 of the Office Action, the Examiner rejected claims 62, 63 and 105 under 35 U.S.C. §103(a) as being unpatentable over Chishti '511 in view of Umeyama and further in view of Chishti '310 and still further in view of Tang.

As pointed above, neither Chishti '511 nor Umeyama would have suggested to one of ordinary skill in the art the use in a finite element analysis based on the contact pairs recited in independent claims 60 and 103.

Moreover, neither Chishti '310 nor Tang discloses or suggests the use of these contact pairs. Therefore, adding Chishti '310 and Tang to Chishti '511 and Umeyama would not have suggested the inventions of independent claims 60 and 103 to one of ordinary skill in the art.

Accordingly, independent claims 60 and 103 are patentable over Chishti '511 in view of Umeyama and further in view of Chishti '310 and still further in view of Tang.

Because independent claims 60 and 103 are patentable over Chishti '511 in view of Umeyama and

further in view of Chishti '310 and still further in view of Tang, dependent claims 62, 63, and 105 are likewise patentable over Chishti '511 in view of Umeyama and further in view of Chishti '310 and still further in view of Tang.

On pages 5 and 6 of the Office Action, the Examiner rejected claims 64 and 65 under 35 U.S.C. §103(a) as being unpatentable over Chishti '511 in view of Umeyama and further in view of Andreiko.

As pointed above, neither Chishti '511 nor Umeyama would have suggested to one of ordinary skill in the art the use in a finite element analysis based on the contact pairs recited in independent claim 60.

Moreover, Andreiko also does not disclose or suggest the use of these contact pairs.

Therefore, adding Andreiko to Chishti '511 and Umeyama would not have suggested the invention of independent claim 60 to one of ordinary skill in the art.

Accordingly, independent claim 60 is patentable over Chishti '511 in view of Umeyama and further in view of Andreiko.

Because independent claim 60 is patentable over Chishti '511 in view of Umeyama and further in view of

Andreiko, dependent claims 64 and 65 are likewise patentable over Chishti '511 in view of Umeyama and further in view of Andreiko.

On pages 6 and 7 of the Office Action, the Examiner rejected claims 70-75, 77-96, and 98-102 under 35 U.S.C. §103(a) as being unpatentable over Sachdeva in view of Chishti '511.

Independent claims 70 and 89 both require performing a finite element analysis based on a movement of the patient's teeth to stored desired positions so as to generate information regarding the effectiveness of the proposed orthodontic treatment.

In Figure 4, Sachdeva describes a method for designing an orthodontic apparatus to provide tooth movement. A model of desired teeth positions is obtained (60). A zero force archwire is generated for each arch based on the model of the desired teeth positions (62). Brackets are placed on the teeth in their desired positions (64).

During this process (60-64), tooth movement is simulated based on the archwire and the brackets and on parameters of the patient and of the orthodontic apparatus. These parameters may include crown

morphology, gum morphology, tooth size, bracket size, wire size, wire elasticity and other mechanical properties of the orthodontic apparatus. The simulation is performed assuming the archwire and brackets installed on the model of actual teeth positions. The teeth movement is simulated to provide zero force between the archwire and the brackets.

If the teeth move to desired positions, the orthodontist accepts the positioning of the teeth. If the teeth do not move to desired positions, alternate archwires, new brackets, and/or bracket placements are selected.

After the brackets are placed on the teeth in their desired positions (64), this placement is transferred to the model of the actual positions of the teeth (66). During this step, tooth movement is simulated and a determination is made as to whether this tooth movement is favorable. If not, an alternate transfer of bracket placement is input and a new simulation is performed.

Figure 6, which is specifically referred to by the Examiner, illustrates an alternative method. A first model of the current teeth positions including brackets



is obtained. A second model of desired teeth positions is obtained. Then, the teeth and corresponding brackets of the first model are positioned in accordance with the second model. Finally, a zero force archwire is generated in accordance with the positioning of the teeth and the corresponding brackets in the desired positions.

As can be seen, Sachdeva does not disclose performing a test by moving teeth to stored desired positions. Instead, Sachdeva simulates tooth movement to a resulting position and compares the resulting position to the desired positions replicated in a model.

That is, Sachdeva does not disclose performing a test while simulating movement of the patient's teeth between modeled first and second positions. Instead, Sachdeva simulates movement of the patient's teeth between a modeled (stored) first position and an unmodeled resulting position. The unmodeled resulting position is then compared to the modeled (stored) desired position to determine if the simulated tooth movement was favorable. (See column 6, lines 62-66.)

Thus, Sachdeva does not perform any test based on a movement of the patient's teeth to stored desired positions as required by independent claims 70 and 89.

Accordingly, Sachdeva does not suggest the test of independent claims 70 and 89.

Moreover, Chishti '511 also does not suggest performing a finite element analysis based on a movement of the patient's teeth to desired positions. As shown in Figure 2 of Chishti '511, the test at 230 compares the resulting position from the finite element analysis to the desired end position. If the two do not match, then a new appliance is designed.

Therefore, since both Sachdeva and Chishti '511 do not disclose running a finite element analysis to desired positions, one of ordinary skill in the art would not have combined Sachdeva and Chishti '511 to produce the inventions of independent claims 70 and 89.

Consequently, for both of these reasons, independent claims 70 and 89 are patentable over Sachdeva in view of Chishti '511.

Because independent claims 70 and 89 are patentable over Sachdeva in view of Chishti '511, dependent claims 71-75, 77-88, 90-96, and 98-102 are patentable over Sachdeva in view of Chishti '511.

On pages 7 and 8 of the Office Action, the Examiner rejected claims 76 and 97 under 35 U.S.C.

§103(a) as being unpatentable over Sachdeva in view of Chishti '511 and further in view of Chishti '310 and still further in view of Tang.

As pointed above, neither Sachdeva nor Chishti '511 would have suggested to one of ordinary skill in the art performing a finite element analysis based on a movement of the patient's teeth to desired positions as recited in independent claims 70 and 89. Moreover, Chishti '310 and Tang also do not disclose or suggest performing a finite element analysis based on a movement of the patient's teeth to desired positions. Therefore, adding Chishti '310 and Tang to Sachdeva and Chishti '511 would not have suggested the invention of independent claims 70 and 89 to one of ordinary skill in the art.

Accordingly, independent claims 70 and 89 are patentable over Sachdeva in view of Chishti '511 and further in view of Chishti '310 and still further in view of Tang.

Because independent claims 70 and 89 are patentable over Sachdeva in view of Chishti '511 and further in view of Chishti '310 and still further in view of Tang, dependent claims 76 and 97 are likewise patentable over independent claims 70 and 89 are

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patentable over Sachdeva in view of Chishti '511 and  
further in view of Chishti '310 and still further in view  
of Tang.

CONCLUSION

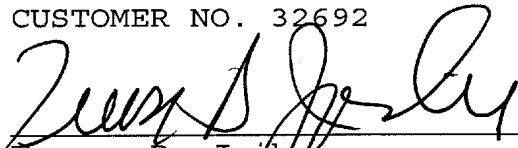
In view of the above, the claims of the present application patentably distinguish over the art applied by the Examiner. Accordingly, allowance of these claims and issuance of the present application are respectfully requested.

The Commissioner is hereby authorized to charge any additional fees that may be required, or to credit any overpayment, to account No. 50 1519.

Respectfully submitted,

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